Effects of Environmental Conditions on Oleic Acid of Sunflower Seeds

Chalermkwan Sukkasem, Paisan Laosuwan, Sodchol Wonprasaid and Thitiporn Machikowa

***Abstract*—**The objective of this study was to investigate the influence of genotypes, planting date, temperature, solar radiation and moisture during seed filling period on oleic acid in sunflower seeds. Field experiments were conducted in four planting dates of two growing seasons (dry and rainy seasons), during 2010–2012, at Suranaree University of Technology, Nakhon Ratchasima, Thailand. Four sunflower varieties (S473, PAC77, PAC33 and PAC22) were planted in randomized complete block design with four replications. Temperature, rainfall, relative humidity and solar radiation were recorded. At maturity, seeds were determined oleic acid content. The results showed that all varieties produced higher oleic acid content in dry season than in rainy season. The highest oleic acid percentage was found in planting date 4 which exhibited high value of solar radiation but low quantities of rainfall and relative humidity during seed filling. It is concluded that rainfall, relative humidity and solar radiation influenced oleic acid accumulation in sunflower seeds.

***Keywords*—** *Helianthus annuus* L., environmental effect, oleic acid, planting date.

I. Introduction

SUNFLOWER oil is an important edible vegetable oil source which contains high level of unsaturated fatty acid. It consists of different types of saturated (palmitic acid, stearic acid) and unsaturated fatty acids (linoleic acid, oleic acid). The quality of sunflower oil is associated with fatty acid composition. Oil with high proportion of oleic acid is more stable than others which is desirable for improved shelf life. Previous research has demonstrated that the fatty acid composition of sunflower oil depends on genetic and environmental conditions i.e. temperature, location, planting date, precipitation and so on [1], [2]. Variation in fatty acid composition proportion by potassium and N fertilization application has been reported [3], [4]. Izquierdo et al. [2] reported that solar radiation had an effect on oleic acid, i.e. oleic acid increased as intercepted solar radiation per plant increased. The variations in oleic acid have been related to temperature during grain filling [5], [6], each 1 °C increase of temperature leads to about 2% increase of oleic acid [7]. In addition, Izquierdo et al. [8] reported that planting date and location are also important factors in determining oil quality. They also showed that oleic acid content was enhanced by high night temperature during early seed filling stage. Therefore, understanding of genotype and environmental effects on oleic acid content is required for fatty acid improvement in sunflower.

The objective of this experiment was to determine the effect of growing conditions i.e. temperature, relative humidity, rainfall and solar radiation during seed filling periods on oleic acid of sunflower varieties.

II. Materials And Methods

This experiment was designed to grow sunflower under different planting dates in order to evaluate the effect of temperature, rainfall, relative humidity and solar radiation during seed filling of sunflower on oleic acid content. Three sunflower varieties including a high oleic acid (PAC22) and low oleic acid (S473, PAC33 and PAC77) varieties were sown in four planting dates. Two planting dates were arranged in dry season during November 2010–February 2011 (P1) and October 2011–February 2012 (P4). Other two planting dates were conducted in early rainy season during June–September 2011 (P2) and late rainy season on July–November (P3), 2011, at Suranaree University of Technology Farm. At each planting date, the plot size was five rows with 5 m and the plant spacing was 0.3 × 0.7 m. The experiment was carried out in a randomized complete block design with three replications. Ten days after emergence, seedlings were thinned to one plant per hill. Temperature, rainfall, relative humidity and intercepted solar radiation during sunflower growing seasons were collected.

At maturity, plants from the central rows were harvested and seeds were dried for 24 h at 60 °C. Then, oleic acid was analyzed by gas chromatography method [9] and oleic acid was expressed as percentage. The analysis of variance was performed using the SPSS computer package [10]. Duncan's multiple range test (DMRT) was applied for means comparison.

III. Results

Means of temperature, rainfall, relative humidity and intercepted solar radiation during sunflower seed filling in two seasons (four planting dates) were shown in Table 1. Averages temperature were not different among four planting dates.

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Rainfall and relative humidity of two planting dates (P1, P4) in dry season were lower than those of two planting dates (P2, P3) in rainy season. While, solar radiation of planting dates (P1, P4) in dry season was higher.

Significant difference for oleic acid was observed among planting dates and among sunflower varieties. However, there was no season × variety interaction for this trait (data not shown). The highest oleic acid was observed in PAC22 (62.40%) which was superior to the rest of the varieties (Fig. 1). The lowest oleic acid percentage was found in PAC33 (33.03%). For planting dates, all varieties grown in dry season produced higher oleic acid than those in rainy season (Fig. 2). The highest oleic acid was observed in P4 (dry season) which has lowest precipitation and relative humidity but has highest intercepted solar radiation (Table 1).

TABLE I
MEANS OF TEMPERATURE, RAINFALL, HUMIDITY AND SOLAR RADIATION DURING SEED FILLING OF SUNFLOWER SOWN IN FOUR PLANTING DATES

Planting date	Temperature (˚C)	Rainfall (mm)	Humidity (%)	Radiation (Cal./cm^2/day)
P1	25.47	18.90	61.32	262.42
P2	27.76	188.25	77.46	220.58
P3	26.15	117.75	72.59	207.28
P4	26.15	40.78	59.62	271.23

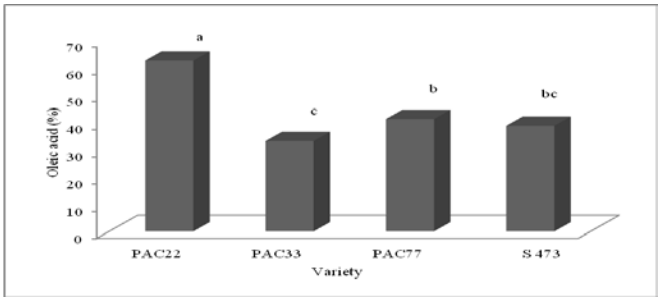

Fig. 1 Average oleic acid content of 4 sunflower varieties

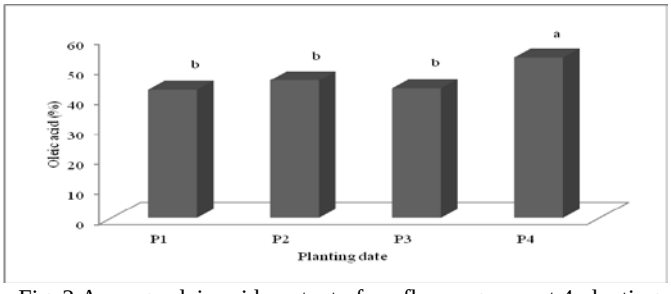

Fig. 2 Average oleic acid content of sunflower grown at 4 planting dates

IV. DISCUSSION

Oleic acid accumulation is affected by genotypes and environmental factors such as quantity of rainfall, relative humidity and solar radiation. In this research, oleic acid in sunflower oil was significantly affected by planting dates. All varieties produced higher oleic acid in dry season than in rainy season. The results also found that solar radiation of P1 and P4 were higher than the rest of the planting dates during seed filling period. Previous literatures reported increasing intercepted solar radiation per plant during seed filling raised the oleic acid percentage and reduced that of linoleic acid [2]. The results of this study complemented that of Mhanhmad et al. [11] who reported that the percentage of oil content and oleic acid in dry season palm kernel oil was higher than in rainy season. Therefore, probable reason for the increase and decrease of oleic acid of different planting dates may be due to the variation of solar radiation and moisture during seed filling. However, the temperature variation during seed filling obtained in our study was not significant differences among planting dates and disagree to that observed in temperature for different sunflower cropping areas in Spain [1] and in Argentina [8].

In conclusion apart from rainfall, relative humidity and intercepted solar radiation during seed filling are the major determinants of oleic acid accumulation in sunflower. Based on these results, management practices that modify temperature, relative humidity and intercepted solar radiation during seed filling period (e.g. planting date, plant density and so on) could contribute to obtain high oleic acid content of sunflower.

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